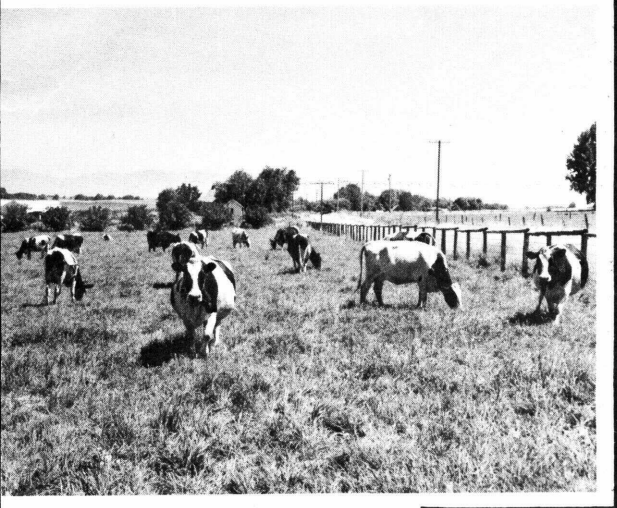
IRRIGATED PASTURES FOR FORAGE PRODUCTION AND SOIL CONSERVATION IN THE WEST



Farmers' Bulletin No. 2230
UNITED STATES
DEPARTMENT OF AGRICULTURE

CONTENTS

This publication supersedes Farmers' Bulletin 1973, Irrigated Pastures for Forage Production and Soil Conservation.

Washington, D.C. Issued November 1967

Irrigated Pastures for Forage Production and Soil Conservation in the West

By Joseph W. Turelle and Wayne W. Austin,[1] *agronomists, Soil Conservation Service*

It is no longer a question of "Will irrigated pastures be profitable?" Now the question is: Will the farm show greater returns from irrigated pasture than it would if land, labor, and capital were used for some other crop? Irrigated pastures frequently produce greater net returns per acre than other field crops. It is not uncommon for irrigated pastures to produce 800 to 1,000 pounds of beef per acre during a 5- to 6-month grazing season.

Forage from irrigated pastures is one of the cheapest sources of feed for livestock. Good pastures provide low-cost, palatable, succulent feed rich in proteins, minerals, and digestible nutrients. Irrigated pastures can be especially profitable where soil limitations, climate, or distance to market restrict the high-value cash crops you can grow profitably.

The dense plant cover of a well-managed irrigated pasture protects against soil erosion and reduces runoff. The effectiveness of good grass-legume sod in controlling erosion is supported by many years of research work carried on at both Federal and State experiment stations as well as by farmer experience.

[1] Retired.

ORE–40,242

Border irrigated pasture with a dense stand of grass over the entire field.

WYO–604

A simple pasture mixture of one grass and one legume.

The dense roots improve the soil and increase its water intake. Their volume, density, and fibrous characteristics contribute to good tilth, permeability, and resistance to erosion. Most grass roots decompose more slowly than legume roots. The combination of decomposing legume roots, which have nitrogen, and the more slowly decomposing grass roots prolongs soil benefits.

Soil improves most rapidly during the early life of irrigated pasture plants, then tends to level off. After a pasture is plowed under, the good tilth and permeability decline under intensive cultivation. The favorable conditions usually disappear after 3 or 4 years. Thus, irrigated pastures in a conservation cropping system are excellent for providing maximum soil protection and improvement.

Planning a Pasture Program

Well-planned and well-managed irrigated pastures can last a long time with proper use of irrigation water, fertilizers, and wise management. They do not, however, hold their high level of production indefinitely even when given the best possible management. Usually you need to reestablish irrigated pastures after they have been in for 8 to 10 years. You can do this by rotating them with cultivated crops. Such rotations eliminate soil compaction, poor plant composition, and weeds. This requires 2 or more years depending on the kind of weeds you are trying to get rid of before you reseed.

Land Selection

Pasture grasses and legumes respond to good land and proper management just as other crops do. With good water management and wise use, it should no longer be a general rule that only poor land be planted to pasture. Satisfactory irrigated pastures can be established on a wide range of soils. Some require extra work or expense. Extremely sandy soils, for example, require frequent irrigations because of low water-holding capacity. Some undulating land makes good irrigated pasture if it can be irrigated by sprinkling or can be leveled economically.

Plant Selection

Simple mixtures of one grass and one legume produce as much or more high-quality forage than complex mixtures in which a number of grasses and legumes are combined. Simple mixtures also simplify grazing management, which is so important in keeping up production, desirable plant composition, dense ground cover, and animal gains.

Some of the more important factors to consider in selecting grasses and legumes for your irrigated pastures are plants that are adapted to your specific soil and climate, palatability, quantity and quality of your irrigation water, the erosion hazard, and the kind of livestock you want to use the pasture.

Grasses and legumes differ as to seasons of lush growth, dormancy, and near dormancy. Some grow most

rapidly during cool weather and are called cool-season plants. Others make their best growth when temperatures are high and are called warm-season plants. Keep this in mind when combining grasses and legumes in irrigated pasture mixtures. Cool- and warm-season plants should not be combined in the same pasture because of the extreme difficulty of properly managing the combination. If you can grow both cool- and warm-season plants, it is best to use them in separate pastures. Where irrigation water is available only during the cool part of the growing season, use only cool-season grasses and legumes.

Cool-season grasses slow down in growth during the heat of summer even under adequate irrigation. Legumes are less affected by high summer temperatures. Combine compatible grasses and legumes and you can hold summer slump in forage production on irrigated pasture to a minimum.

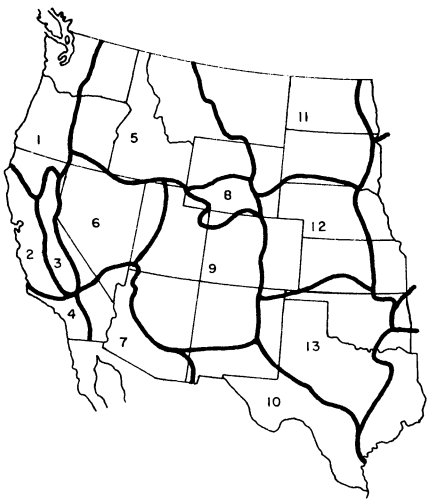
For sloping land where erosion is a problem, include at least one sod-forming grass in the mixture. To provide protective ground cover until the perennial grasses are established, you may need to add a fast-growing, short-lived grass.

It is impossible here to list all grasses and legumes that are locally adapted for irrigated pastures. Much research work has been done by State and Federal experiment stations on improved forage species and varieties. This information is available from your county agent and the local ASCS office in each county or a Soil Conservation Service man assigned to your soil conservation district. Table 1 contains a partial list of major grass and legume species adapted to each of the areas shown on the map below. It also includes major plant characteristics and soil, water, and management requirements for the species.

Size and Number of Pastures

Each planned pasture program must be based on the grazing season, kind and number of livestock carried, forage species, and water available for irrigation. But just as important is the level of management. High level management may permit three to four times as great a stocking rate as poor level management (table 4).

You can decide on the stocking rate best suited to your individual operation after a grazing season or two. Then adjust the stocking rate to meet the management objective you have set.



1—Pacific Northwest Coast Ranges, Valleys, and Cascades
2—Central California Coastal Belt and Range
3—California Interior Valleys and Sierra Nevada Range
4—Southern California Mountains and Coastal Plain
5—Columbia Basin and Northern Rocky Mountains
6—Nevada—Great Salt Lake Basins and Plateaus
7—Southwest Basins and Ranges
8—Northern Desert Basins, Mountains, and Plateaus
9—Colorado and Green River Areas and Southern Rocky Mountains
10—Rio Grande Plains and Desert Basins, Plateaus, and Mountains
11—Northern Great Plains
12—Central Great Plains
13—Southern Great Plains

Regions of species adaptation for irrigated pastures.

TABLE 1.—*Adaptation and growth characteristics of major grasses and legumes for irrigated pastures*

Species	Regions and major soil and site adaptations	Growth characteristics	Palatability
Grasses:			
bahiagrass	Region 10; adapted to fine and moderately coarse textured soils.	Warm-season, dense-tufted, stout rhizomes.	High.
bermudagrass	Regions 3, 4, 7, 10, and 13; adapted to a wide range of soils.	Warm-season perennial with stolons; low to medium height.	High.
bluegrass, Kentucky	Regions 5, 8, 11, and 12; adapted to a wide range of soils but does best on well-drained medium- to fine-textured soils; not salt tolerant; not usually planted for irrigated pastures.	Cool-season, sod-forming; slow growth during high temperature; short to medium height.	High.
bromegrass, smooth	Regions 1, 2, 3, 5, 6, 8, 9, 11, and 12; requires well-drained fertile soils for best results; adapted to most soil textures but does best on medium-textured soils; withstands some salt.	Cool-season, erect sod-forming perennial; strong rhizomes; poor recovery in hot weather; loses forage quality after frost.	High.
buffelgrass	Regions 7, 9 (South), and 10; adapted to a wide range of soils including droughty soils; does well on fine- and coarse-textured soils; must be fertilized to maintain highest production.	Perennial with short rhizomes; vigorous summer growth; high forage producer; drought tolerant.	High.
canarygrass, reed	Regions 1, 5, 8, 9 (North), 11, and 12 (North). Does well on moist or wet soils and will withstand dry soils after the grass is fully established, slightly salt tolerant on wet soils; also adapted to peat and muck; high fertility requirements.	Cool-season leafy perennial; coarse when nearly mature; short rhizomes.	High, if grazed close or regularly clipped.
dallisgrass	Regions 3 (South), 4, 7, and 10. Adapted to wide variety of soils but does best on fine-textured soils; withstands salt, flooding, and poor drainage.	Warm-season long-lived perennial bunchgrass; spring, summer, and early fall grazing.	High.
fescue, tall	Regions 1, 2, 3, 5, 6, 8, 9, 11, and 12. Adapted to medium- and fine-textured soils; grows well on moist to well-drained areas; withstands moderate salt, low fertility, and moderately acid soil. Regional	Leafy perennial bunchgrass; green all summer; good regrowth.	Medium to high.

	strains permit widespread use throughout most of the West.		
foxtail, creeping	Regions 1, 5, 8, 9, 11, and 12 (North). Adapted to moist soils, overflow lands, peat, or muck; does well on medium- and fine-textured soils of good fertility; slightly salt tolerant.	Cool-season grass, long-lived perennial with strong rhizomes; seed usually black; plants vigorous.	High.
foxtail, meadow	Adapted to same areas as creeping foxtail...	Cool-season long-lived perennial with short rhizomes; heads resemble timothy; lighter colored seed than creeping foxtail; fairly dense sod.	High.
oatgrass, tall	Regions 1, 5, 6, 8, 9 (North), 11, and 12; adapted to droughty to moderately well-drained soils; sensitive to wet and salt-affected soils; withstands shade.	Cool-season short-lived perennial bunchgrass; young plants vigorous. Recovers rapidly after grazing.	High.
orchardgrass	Regions of adaptation same as tall oatgrass. Adapted to moderately drained soils but not well adapted to salt-affected soils; will not do well on soils of low fertility and eroded soils and will not stand flooding.	Cool-season perennial bunchgrass. Tolerates shade. Recovers well after grazing; good seedling vigor. Produces large root volume.	High.
pangolagrass	Region 10. Grows well on coarse-textured soils but requires fertilization for sustained maximum production; best adapted to moist, well-drained soils; does not grow well on flooded soils.	A rapid growing vigorous, leafy perennial. Must be propagated vegetatively; drought resistant.	High.
panicum, blue	Regions 7, 10, and 13. Requires fertile soil and good drainage.	Tall, vigorous perennial; extensive root system. Seedlings establish slowly but growth rapid 6 to 8 weeks after germination; can withstand silt deposition, forms new plants at buried nodes. Requires a well-drained soil and good fertility.	High, if not too mature.
rhodesgrass	Regions 2 (South), 3, 4, 7, 10, and 13. Adapted to wide range of soils but does best on fine-textured soils; withstands some wetness and salt.	Warm-season, sod-forming perennial; easily established, aggressive high producer. Usually does not survive temperatures below 10° F. Grows well in spring, summer, and early fall.	High.
ryegrass, perennial	Adapted to most western regions of the United States with the possible exception of the extreme southwest basins; does best on well-drained soils of good fertility; survives in moderately wet soils.	Short-lived perennial bunchgrass; easily established; grows early spring to late fall and continues during winter in warmer climates; production moderate; often used for quick cover.	High.

TABLE 1.—*Adaptation and growth characteristics of major grasses and legumes for irrigated pastures*—Continued

Species	Regions and major soil and site adaptations	Growth characteristics	Palatability
sudangrass	Adapted to virtually all western regions of the United States; grows in a wide variety of soils but prefers well-drained medium-textured soils.	Warm-season annual; excellent producer for summer grazing. Often used as a supplemental pasture.	High.
timothy	Adapted to Regions 1, 2 (North), 3 (high elevations), 5, 6 (North), 8, 9 (North), 11, and 12; high altitudes in mountain zones; does well on virtually all soils except coarse-textured soils; requires moist soils; withstands poor drainage; not salt tolerant. Used frequently on burned-over areas in mountains and foothills.	Cool-season, short-lived perennial. Provides early spring to late fall grazing.	High.
wheatgrass, intermediate	Regions 1, 5, 6 (North), 8, 9 (North), 11, and 12; requires well-drained soils and medium to high fertility; does best on medium- to fine-textured soils; not too tolerant to salt.	Cool-season, sod-forming perennial; easy to establish; excellent seedling vigor. Usually makes a dense, leafy ground cover the first year.	High.
wheatgrass, tall	Regions 1, 5, 6 (North), 8, 9 (North), 11, and 12; best adapted to medium- and fine-textured soils; one of the most successful grasses on saline and saline-alkali soils.	Cool-season, tall, coarse bunchgrass; vigorous; late maturing allows grazing into the summer months.	Medium to high.
wildrye, Russian	Regions 5, 6, 8, 9, 11, and 12. Adapted to medium- and fine-textured soils; not well adapted to coarse-textured soils; good salt tolerance; requires high fertility.	Cool-season, perennial bunchgrass; densely tufted with mass of basal leaves. Growth begins in spring but leaves remain green throughout most of summer, providing good summer and fall grazing.	High.
Legumes:			
alfalfa	Adapted to virtually all of the West; grows well on medium-coarse to fine-textured well-drained or acid soils or soils having high water table; tolerates moderate salt-affected soils.	Perennial; extremely productive; valuable in irrigated pastures despite bloat hazard; easily established; best with grass for pasture use; grows spring, summer, and early fall.	High.
clover, alsike	Regions 1, 2 (North), 3 (high elevations), 5, 6, 8, 9 (high elevations), 11, and 12; grows in moderately coarse to fine-textured soils; withstands poorly drained and acid soils; adapted to high altitudes.	Short-lived perennial; late spring, summer, and early fall grazing; valuable on soils too moist for other legumes.	High.

clover, Ladino	Adapted to cool temperate regions; grows best on moderately coarse to fine-textured soils; slightly tolerant of acid soils but not of salty wet soils.	Moderately long-lived perennial. Spreads by creeping stems. Grows well in a grass mixture. Spring, summer, and early fall grazing.	High.
clover, red	Regions 1, 2, 3 (North), 5, 6, 8, 9 (North), 11, and 12. Adapted to medium- and fine-textured soils; grows in somewhat poorly drained and moderately fertile soils.	Biennial, established easily; spring, summer, and early fall grazing.	High.
clover, strawberry	Regions 1, 2, 5, 6, 8, 9 (North), 11, and 12. Well adapted to continuously wet soils; most tolerant legume to salty soils; survives long flooding.	Perennial, low-growing plant; spreads by stolons; low producer; slow to establish especially on salt-affected soils.	High.
clover, white	Regions 1, 2, 3 (higher elevations), 5, 6, 8, 9, 11, and 12. Best adapted to fine- and medium-textured soils; also to well-fertilized coarse textured soils with a high water table.	Perennial and prostrate; not very productive but persistent under grazing because of low growth; not often seeded in irrigated pasture mixtures but much appears voluntarily. Spring, summer, and early fall grazing.	High.
sweetclover, white and yellow.	Adapted to virtually all the West; grows on a wide range of soils; withstands moderate salt but not acid.	High-producing biennial; coarse for grazing if allowed to grow above 12 to 18 inches. Does well in pasture mixtures; bloat hazard reduced when mixed with grass.	High.
trefoil, birdsfoot	Regions 1, 2, 3, 5, 6, 8, 9, 11, and 12; grows on a wide range of soils but does best on fine-textured soils; does well on soils with moderate fertility and on moist foothills or bottom lands.	Leafy fine-stemmed perennial. Bloat hazard; deep, mostly fibrous roots; heat resistant; slow to establish and slow to recover after grazing.	High.

268-794 O—67——2

Animal units can be determined from the following equivalents:

Mature cow—1 animal unit.

Two-year old (26 to 32 months)—0.85 animal unit.

Long yearling (20 to 26 months)—0.75 animal unit.

Yearling (14 to 20 months)—0.60 animal unit.

Weaned calves (8 to 14 months)—0.50 animal unit.

Calves (2 to 8 months)—0.25 animal unit.

Bull—1.25 animal units.

Sheep (18 months)—0.2 per head or 5 per animal unit.

Yearling sheep (13 to 18 months)—0.14 per head or 7 per animal unit.

Weaned lambs (7 to 13 months)—0.09 per head or 11 per animal unit.

Lambs (2 to 7 months)—0.06 per head or 17 per animal unit.

Planning the Harvest

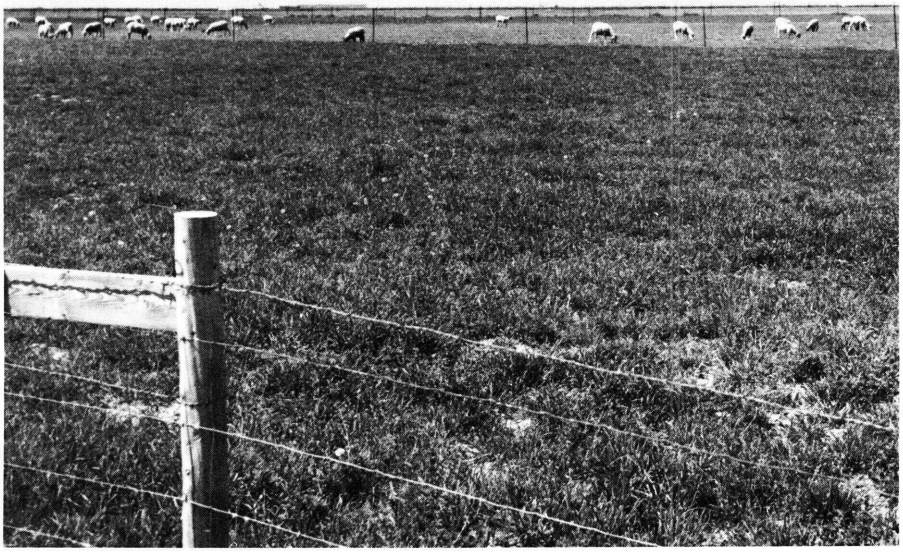
Pastures can be harvested with animals by continuous grazing; rotation grazing; or daily-ration grazing, sometimes called strip grazing. Or they can be harvested by "green-chop."

Continuous grazing usually is the least desirable method. First, you don't have enough control of the grazing animals to prevent them from selecting only the pasture plants they like best. This results in a "patchy" pasture. In a short time the highly palatable high-producing plants are gone. Second, with grazing animals present at all times you can't prevent severe trampling while the pasture is being irrigated. This compacts the soil and damages the plants themselves. Third, continuous grazing encourages weeds.

Rotation grazing is an intensive way of harvesting irrigated pasture with animals. Separate grazing units are pastured in a systematic order throughout the grazing season. Experience has proved that four are the fewest units practical for a rotation system. Two irrigations are generally needed during regrowth unless there is rain.

Daily-ration grazing is a special form of rotation grazing.

The green-chop method of harvest-



IDA–45,346

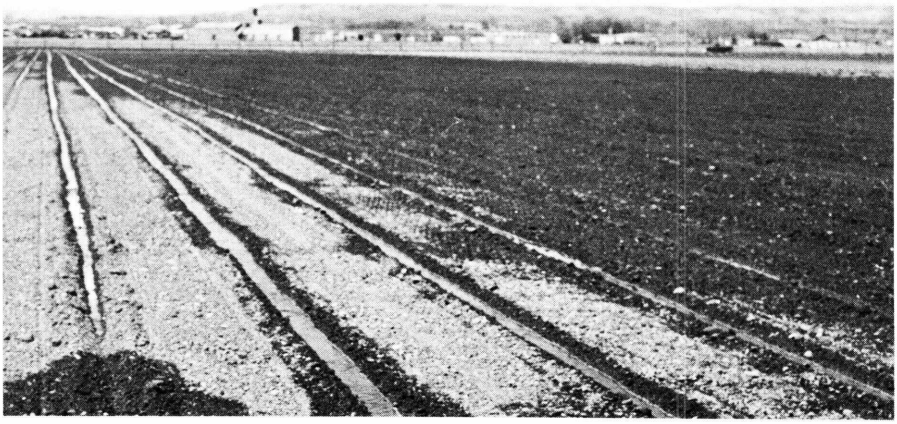
Sheep grazing on rotation irrigated pasture. Unit in foreground is in plant regrowth period.

ARIZ–5456

Harvesting irrigated forage for green chop.

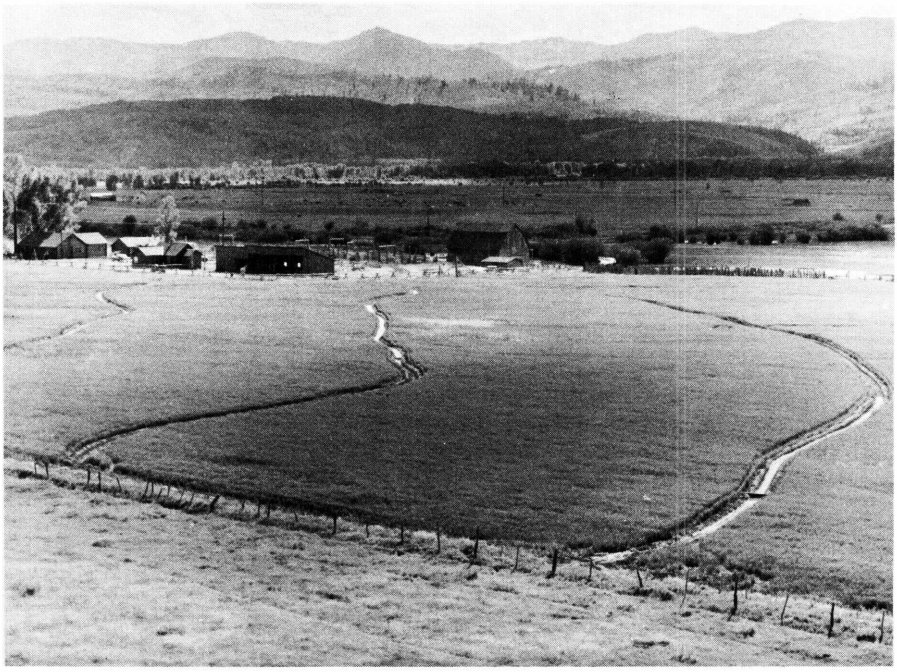
IDA–45,291

Feeding green chop.



WYO–10,164

A well-packed seedbed and a good irrigation system help make good pasture.



WYO–701

Contour ditches used on field too sloping for border irrigation.

ARIZ–5330

Leveling land for irrigated pasture.

ing pastures is often referred to as "zero grazing." The forage is chopped green in the field and hauled to livestock. Usually it is used with large herds—100 head or more; machinery costs are generally too high for smaller herds.

Methods of Irrigating

You should plan your irrigation system as an integral part of your conservation plan. The irrigation method you choose depends on topography; depth, texture, permeability of soil and subsoil; amount of water available; rate of water delivery; surface drainage; and cost of water. Border, contour ditch, corrugation, and sprinkler are all suitable methods for irrigation. Because of the many variables, you should consult your local SCS conservationist for detailed information on layout.

Unless the pastures are to be sprinkler irrigated, the land should be leveled and, if needed, proper drainage installed. Cost of leveling land for gravity irrigation varies considerably, but $60 to $80 per acre is not uncommon.

In border irrigation, water is applied between low parallel dikes on level or nearly level land. It is an efficient way of irrigating close-growing crops such as pastures. The length and width of a border strip depends on the available water supply and the intake rate of the soil.

Contour ditches provide a practical method of irrigating pastures where land cannot be economically leveled or where fields are sloping. How far apart the ditches should be depends on the topography and the soil. Siphon tubes and gated pipe provide efficient ways of discharging water from supply or head ditches.

Corrugations are small ditches usually put in between contour ditches after seeding the pasture mixture. They are run directly down the slope. Their length depends on the soil and slope. They are spaced so the area between them will be wet across the surface by the time the water fills the root zone. Water is applied through siphon tubes or gated pipe into the corrugations. Streams must be small.

Corrugations may be used with either borders or contour ditches to give better distribution of water and minimize erosion.

Sprinkler irrigation is one of the best methods for establishing pastures. Since fields do not require land leveling it can be used on rolling or rough topography or on shallow soil. It is a highly efficient way of irrigating coarse sandy soils that take in water rapidly. Steep slopes can be irrigated with less erosion hazard. And in most places a sprinkler system gives more even distribution of water than other methods. Its chief disadvantage is that it is hard to get an even distribution of water when the wind is blowing.

Getting the Plants Started

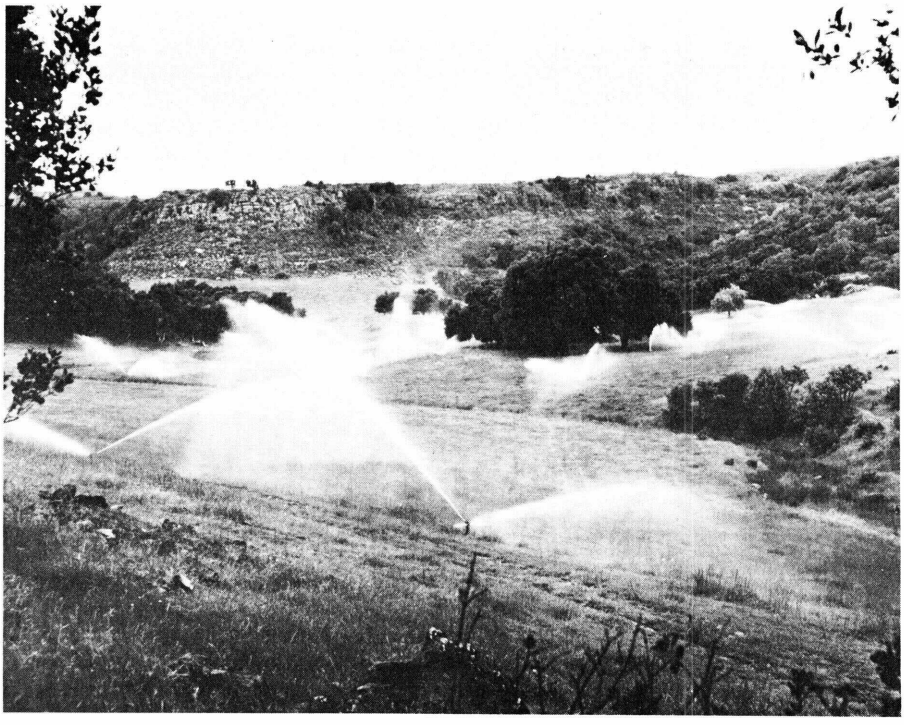
Since irrigated pasture occupies land longer than most other field crops, it pays to see that the plants get a good start. Your objectives are to use minimum amounts of water and labor and to make sure of high yields for the life of the stand.

To assure satisfactory establishment of all species in the mixture, apply a preplanting irrigation to provide deep moisture to the growing plants as they extend their roots.

Preparing the Seedbed

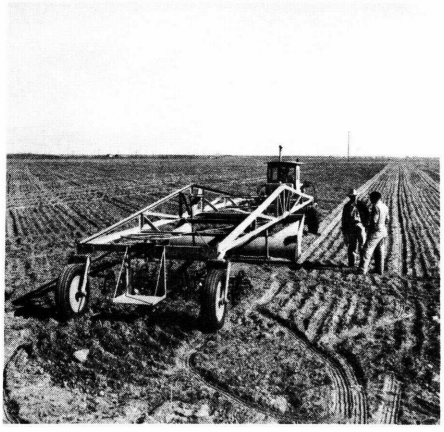
A firm seedbed is essential for establishing an irrigated pasture. A firm seedbed should not permit the footprint of a 160-pound man to sink into the surface more than 3/8 to 1/2 inch. Use a packer if the soil is loose.

Plant a preparatory or cover crop such as sorghum, sudangrass, or small grain in a field that is subject to wind erosion. After clipping or harvesting



CAL—7273

Sprinkler irrigation used on rolling land.



WN–90,270

Landplane equipped with a springtooth harrow roughens land after planing to help control wind erosion until vegetation is established.

this crop as hay, drill the pasture mixture into the stubble without any further tillage.

When To Plant

Most perennial grasses and legumes for irrigated pastures can be planted in either spring, late summer, or early fall. Warm-season grasses are usually planted in late spring as they do not germinate satisfactorily in cool weather.

Late summer or early fall is a good time to plant if the soil is moist enough. Fewer irrigations are required for establishment, weed competition is less, and grazing may be available the next fall. Fall seeding is distinctly preferable to spring seeding on sites infested with perennial weeds because you have more time to get rid of the weeds. Plant early enough to allow 6 to 10 weeks of growing weather. Legumes especially should be firmly established before cold weather sets in.

Seed Quality

It pays to purchase certified seed to make sure that it is the proper variety, free of noxious weeds, and high in quality.

Satisfactory ready-mixed seed mixtures can sometimes be purchased from seed companies. Often the precise grass-legume combination you want is not available. It is better to purchase the seed separately rather than accept a mixture containing species not needed or perhaps not well adapted for seeding your particular pasture.

Rates of Seeding

Rates of seeding are best determined locally. They should be based on "live-pure" seed. Consult your county agricultural agent or the SCS conservationist assigned to your local soil conservation district for this information.

Methods of Seeding

To get uniform stands, seeds must be placed at the proper depth. Seeding depths should generally not be more than 3/4 to 1 inch for large seeds and 1/4 to 1/2 inch for small seeds.

Drilling is by far the best method of seeding. Drills give both even distribution and, equipped with depth bands on the furrow openers, precise depths of seeding.

Packer seeding also places the seed in the soil and covers it, but not so precisely.

Broadcasting usually requires more seed per acre. You must follow broadcast seeding with a packer to cover as much of the seed as possible.

Alternate row seeding of grasses and legumes—that is, seeding grass in one or two drill rows and alternating with one row of legumes—is a desirable seeding method. You can obtain alternate rows of grasses and legumes by plugging feed holes in the legume seeder box and in the box through which the grass is seeded. Alternate row seeding is highly useful where you have difficulty establishing a slow-starting legume along with a grass that grows rapidly. An excellent example of such a combination is tall fescue and birdsfoot trefoil. Another important advantage of alter-

nate row plantings is that legumes may stay in your stands much longer.

Cross seeding approaches results obtained with alternate-row seeding. First you drill your grass seed in one direction and then overdrill your legume seed crosswise. This will reduce the direct competition between the young grass and legume plants.

Inoculation of Legumes

Legume seed should always be inoculated. Certain legumes such as birdsfoot trefoil require a special inoculant. Get local information for the correct kind of inoculant to use in your area.

Companion Crops

The most rapid establishment and vigorous stands are obtained when pasture mixtures are seeded without a companion crop. Companion crops compete for soil nutrients, light, and moisture. If local conditions require that you use one, plant the companion crop in rows that are not less than double the usual distance between rows. Then seed the pasture mixture crosswise to these rows.

You need to irrigate more frequently when you use a companion crop. But irrigate for the pasture mixture, not the companion crop.

ORE–75,231

An excellent stand of orchardgrass and birdsfoot trefoil in alternate rows.

Management During Establishment

Your first objective after seeding a pasture is to manage the new seedlings so that the new plants establish themselves firmly.

Newly seeded pasture should never want for water.

During the first 20 to 30 days, irrigate often enough to prevent surface drying of the soil. Afterwards irrigate often enough to keep the root zone moist. Five irrigations are not unusual for complete establishment.

Pastures seeded in spring often require one to three more irrigations for establishment than those seeded in late summer or early fall.

Make the first irrigation, which moistens only the top few inches, with a small head of water to avoid disturbing seed and soil.

Give new pastures time to become fully established before starting regular grazing. In the North it is best to skip grazing entirely during the first growing season. In the South, where the growing season is longer, the grasses and legumes may grow rapidly enough to permit some grazing. But it should be light and for only a short time.

Clipping may be necessary if there is competition from weeds. Set the cutting bar or blades at least 3 inches high—close clipping stunts growth. Or, if you choose, use herbicides. Seek advice in the use of selective herbicides for weed control from your county agricultural agent who has detailed information on the proper and safe use of such chemicals.

Managing Established Pastures

Irrigation Water

The frequency of irrigation depends on soil, plant, and climate. Generally, pastures use about ¼ inch of moisture per day but may use ⅓ inch per day during hot dry weather. Sandy soils require more frequent and lighter irrigations than finer textured soils. Irrigation during periods of peak consumption may be as frequent as 7 to 10 days on loamy soils and 4 to 5 days on sandy soils.

Apply water before the readily available moisture in the root zone has been reduced to 50 percent of the water-holding capacity.

For efficient irrigation you need to supply water for the root zone of the grass in the mixture—generally about 3 feet. Once or twice in the season you need to fill the root zone of the deeper rooted plant. To fill the root zone of alfalfa, for instance, you need to irrigate to 5 or 6 feet.

Often 3 to 6 inches of water is needed. A good way to determine when and how much to irrigate is to squeeze a sample of soil into a ball. Table 2 gives the criteria for determining how much moisture is in the soil by this "feel" method.

Several gages that help in estimating soil moisture needs are on the market. These may be installed in various fields and read directly.

Twenty-four to forty-eight hours following irrigation, check with a probe or auger to determine whether moisture was added to the desired depth and whether it has good distribution over the field.

Never irrigate while livestock are grazing. Rotate pastures so that irrigation water can be applied immediately after the livestock are removed. Then irrigate once or twice more during the plant regrowth period. Allow 2 or 3 days drying time after the last irrigation before livestock are returned to the pasture.

Fertilizing

Grasses and legumes in a pasture require nutrients for high-level production. Many areas need lime as well. Before a pasture is planted, take soil samples to determine the amount and kind of fertilizer needed. There are variations between farms, within farms, and even among fields so soil tests are essential.

Both grasses and legumes respond to barnyard manure. A top dressing of manure and proper irrigation often increases yields as much as 50 percent. The beneficial effects are largely due to the nitrogen and organic matter but manure also provides potassium, important in maintaining legumes. Phosphate, however, is low.

Grasses are heavy users of nitrogen. They usually respond favorably in both volume and protein content to the nitrogen in mineral fertilizers. Split applications of nitrogen fertilizer during the growing season are most effective —in early spring and in summer. Applying very high rates of nitrogen, however, may interfere with the legumes in the mixture. Grasses could crowd out the legumes if you use too much nitrogen.

Legumes respond to phosphorus. Soil should always be tested to determine phosphorus needs. Apply phosphorus in the spring or late fall.

Mixtures of grasses and legumes often respond more favorably to a combination of nitrogen and phosphorus than to either alone.

Western soils usually have enough potash. But when fields have been producing cash crops under irrigation for a long time or when harvesting is by green chop, you may need to add potash. Leaf discoloration may show a potash deficiency. Or you can find out through plant tissue tests, field observation, and soil tests. Peat and muck soils usually respond to potash.

Both legumes and grasses respond to sulfur in many soils. Sulfur deficiencies, particularly in the West, are appearing more and more frequently.

TABLE 2.—*Practical interpretation chart of soil moisture for various soil textures and conditions*

Available moisture in soil	Feel or appearance of soil			
	Coarse-textured soils	Moderately coarse textured soils	Medium-textured soils	Fine and very fine textured soils
0 percent	Dry, loose, and single-grained; flows through fingers.	Dry and loose; flows through fingers.	Powdery dry; in some places slightly crusted but breaks down easily into powder.	Hard, baked, and cracked; has loose crumbs on surface in some places.
50 percent or less	Appears to be dry; does not form a ball under pressure.[1]	Appears to be dry; does not form a ball under pressure.	Somewhat crumbly but holds together under pressure.	Somewhat pliable; balls under pressure.
50 to 75 percent	Appears to be dry; does not form a ball under pressure.	Balls under pressure but seldom holds together.	Forms a ball under pressure; somewhat plastic; slicks slightly under pressure.	Forms a ball; ribbons out between thumb and forefinger.
75 percent to field capacity.	Sticks together slightly; may form a very weak ball under pressure.	Forms weak ball that breaks easily; does not slick.	Forms ball; very pliable; slicks readily if relatively high in clay.	Ribbons out between fingers easily; has a slick feeling.
At field capacity (100 percent).	On squeezing, no free water appears on soil but wet outline of ball is left on hand.	Same as for coarse-textured soils at field capacity.	Same as for coarse-textured soils at field capacity.	Same as for coarse-textured soils at field capacity.
Above field capacity.	Free water appears when soil is bounced in hand.	Free water is released with kneading.	Free water can be squeezed out.	Puddles; free water forms on surface.

[1] Ball is formed by squeezing a handful of soil very firmly.

IDA–45,344; IDA–45,345

Two views of rotation grazing: (Top) At the start of the grazing season; (Bottom) In various stages of regrowth.

TABLE 3.—*Rotation grazing cycles for 4 to 8 paddock pastures*

Number of pastures	Rotation cycle	Regrowth period	Grazing period
	Days	*Days*	*Days*
4	28	21	7
5	35	28	7
6	36	30	6
7	35	28	7
8	32	28	4

It is advisable to consult your county agent or SCS conservationist for details on kind, time, rate, and method of fertilizer application for irrigated pastures in a specific location.

Proper Pasture Use

Harvesting and irrigation are the key factors in good pasture management. Harvesting concerns particularly method, stocking rate, and regrowth period. But erosion control, when to start grazing, and amount of stubble left at the end of the grazing year for sustained production are also parts of proper pasture use.

Continuous grazing is the least efficient method of harvesting an irrigated pasture (p. 8). It results in lower production, wasted forage, irrigating while livestock are in the pasture, and patchy grazing.

Rotation grazing is the most common method of grazing irrigated pastures. Pastures are divided into four or more units. The system should allow for the necessary forage regrowth. The fewer the fields the less labor required but the longer the livestock will need to graze in each field. And long grazing periods tend to reduce the productivity of a pasture.

Labor costs and the cost of dividing pastures can be reduced by using electric fences instead of permanent ones.

Table 3 shows some typical rotation-grazing cycles that provide for different forage regrowth periods.

Daily-ration or strip grazing is a special form of rotation that provides forage for only 1 day—or occasionally ½ day of grazing. Electric fences divide pastures into the 1-day grazing areas. Since there is no surplus, the animals graze all the forage evenly. This method of grazing seems to be highly efficient and most economical for dairy cattle.

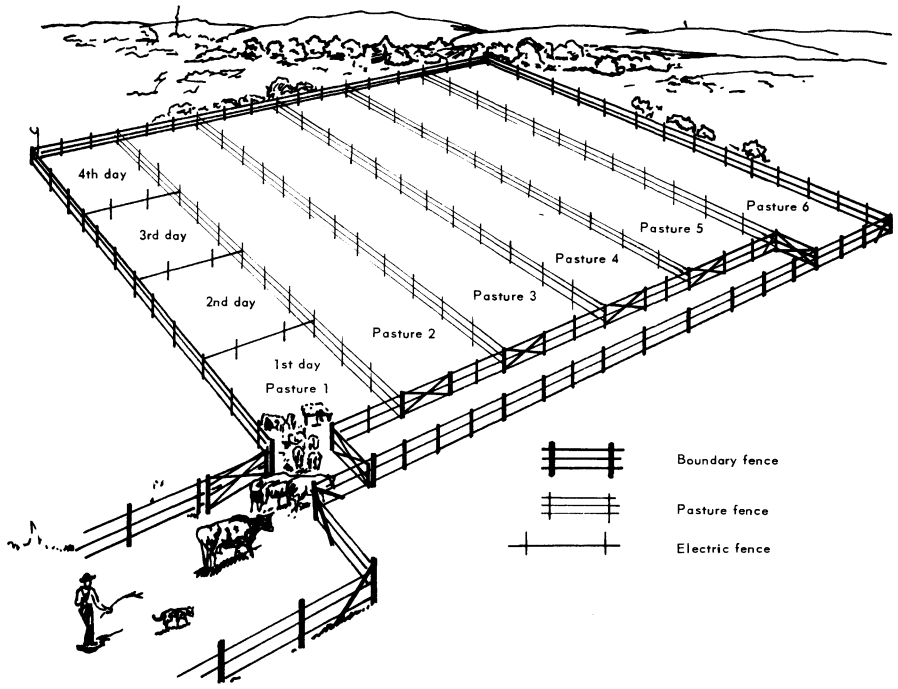
Two plans for daily-ration grazing in a 24-day ration cycle are illustrated here. Both can be modified in several ways.

Occasionally spring growth is so rapid that the forage cannot be adequately harvested by grazing. In such seasons one or more pastures can be used for hay or silage. The mowed pastures then pass through a regrowth period and livestock graze them the next time around.

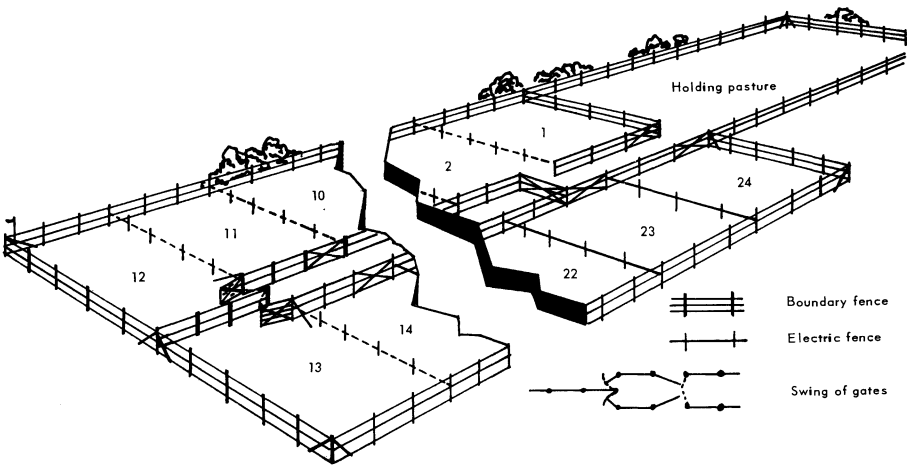
To maintain plant vigor and yield under any system of rotation grazing, the same field should not be grazed first each year.

Seasons of Grazing

You can start grazing your irrigated pasture at the beginning of the pasture season when the grasses have grown to a suitable height. It must not be grazed so low as to weaken the plants. Only in strip grazing can the forage be heavily pastured. This is permitted because the grazing period is very short. Consult your SCS conservationist or county agricultural agent on best stages of plant growth for grazing. Local information is needed as this



One plan for daily-ration grazing. This plan provides for six pastures and a 24-day rotation cycle. Gates open into each pasture from a side lane. They either block a lane or close a pasture. Pasture 1 is grazed for 4 days. An electric cross fence is moved back for the second- and third-day grazing and removed for the fourth. Pasture 1 is then closed and pasture 2 is divided and grazed in the same way, then 3, 4, 5, and 6. On the 25th day the livestock are returned for 1st-day grazing of pasture 1 and the rotation is repeated.



A plan for daily-ration grazing in which cattle do not trample over previously grazed lots. This plan provides for 24 separate pastures, each having an opening from a central permanent lane. Each provides 1 day's feed. Pastures are grazed in the order numbered. Portable electric fences are used as cross fences; only two strings of electric fence are required. Each day one string is moved or humped over the other.

varies with local environmental conditions. Stop grazing in the fall early enough so the grasses and legumes can make a good top growth before winter. The food manufactured in the top growth is carried to the roots where it is stored for use by the plants when growth starts in the spring. This also allows the plants to build up good root reserves, which reduces danger of winterkilling.

Plants that are closely grazed at the end of the growing season are subject to winterkill and heaving and are slow to start growth the next spring.

Table 4 gives criteria for determining different levels of irrigated pasture management.

Stocking Rates

Grazing on established irrigated pastures should always be heavy enough to prevent the plant species from reaching full maturity. Forage at full maturity is not palatable. Moreover, the protein content of plants goes down markedly as they approach maturity. On the other hand, overuse of pastures is detrimental in that they become less productive, plants lose their vigor, and finally the stands are depleted. For highest returns, stock a pasture at a rate that permits vigorous plant growth and uniform use of the forage. The stocking rates of any irrigated pasture depend on the level of management and kind of land. A high level of management may

TABLE 4.—*Criteria for determining different levels of irrigated pasture management*

Criterion	Level of management		
	High	Good	Fair
Grazing:			
Days in each pasture [1]....number..	4.....	6.....	7.
Pastures....number..	8.....	4.....	3.
Height of forage when grazing starts at beginning of season..inches..	8.....	6.....	4 to 6.
Height of forage when grazing ends at the close of season...inches..	4.....	3.....	2.
Days of regrowth between grazings [2]....number..	24 to 35.....	18.....	14.
Irrigation:			
Irrigations during regrowth period....number..	2 or 3.....	1 or 2.....	1.
Days first irrigation occurs after livestock removed.....number..	Immediately..	2.....	3.
Days last irrigation occurs before livestock returned.....number..	3 or 4.....	2 to 4.....	1 or 2.
Legumes in pasture mixture.....percent..	50.....	30 to 40.....	20.
Commercial fertilizers: [3]			
Available nitrogen per acre...pounds..	80 to 100.....	50.....	0 to 30.
Available phosphorus per acre.pounds..	50 to 60.....	45 to 50.....	0 to 30.
Nitrogen applications per season....number..	2.....	1 or 2.....	1.
Phosphorus applications per season....number..	Once early spring.	Once early spring.	At seeding time.
Dragging and clipping.....	4 or 5; after cattle are removed.	2; early spring and midsummer.	0 or 1; early spring.

[1] Daily ration or strip grazing is also a criterion for high level of management.
[2] Usually depends on the legume in the pasture mixture.
[3] Potash for legume maintenance and on fields of green chop necessary for high level of management.

result in a stocking rate 3 to 4 times as great as that under a poor level of management.

Mowing

Well-managed pastures require very little, if any, mowing. It is often the undergrazed pastures that require mowing. If weeds are a problem they should be mowed to keep them from spreading seed and from competing with pasture plants for nutrients, moisture, and light.

Spreading Droppings

If animal droppings are not spread, they smother the plants under them and become surrounded by rank forage that is avoided by grazing livestock. Spreading brings about better use of the manure as fertilizer and more even harvest of the forage. Droppings can be spread by harrowing, dragging a link chain, or some other method. All pastures should be harrowed either in the fall or in early spring before growth starts and two or three times more during the grazing season.

Bloat

Bloat is an age-old problem in ruminant animals. Irrigated pastures with a high percentage of legumes, 60 percent or more, are a potential bloat hazard. Research is being carried out by State and Federal experiment stations on the prevention of bloat and considerable progress is being made.

There are several things you can keep in mind to reduce your chances of having bloat problems:

- Since young succulent legumes cause most of the bloat, hold the legume to 50 percent or less of the total forage composition. Generally one-fourth to one-third legume seed by weight will result in a 50-percent legume forage. The best way to make sure the pasture mixture has the proper ratio is to seed the legume and grass in alternate rows.
- Use a nonbloating legume in the mixture; for example, birdsfoot trefoil, where adapted.
- Use rotation grazing to eliminate selective grazing by animals.
- Cut new seedlings that are high in legumes for hay, green chop, or silage.
- Never turn thirsty or hungry animals on green succulent bloat-producing forage.
- Feed your animals coarse roughage such as dry cereal hay, straw, or well-cured sudangrass or forage sorghum before you turn them into a pasture high in legumes. Or place feed bunkers in the pasture before you turn the animals in and keep them full of the dry forage. Your animals will eat some dry forage. This helps to make them belch. The belching releases the built-up gas in their stomachs.
- A few days before turning your livestock into pasture, mow strips through the pasture and place the mowed forage in small windrows to supply dry feed for the animals when they are first turned in. This is not quite so good as providing dry, coarse hay in feed bunkers in the pasture since the mowed forage itself is high in legumes.
- Have plenty of water and salt and other minerals available to your animals when on irrigated pasture. Provide trace-mineralized salt in areas where needed. Salt aids digestion and reduces the initial hunger for succulent green feed.
- Use chemical preventives. Such compounds are appearing on the market. Ask your county agricultural agent for more information on these substances.

Ergot Poisoning

Although ergot poisoning is not likely to occur in a well-managed irrigated pasture it is well to be on your guard. It is a fungus that attacks some grass plants. It occurs after the plants reach the flowering stage and continues on through seed development.

Animals that have consumed enough

An annual sudangrass pasture.

of the infected grass have a staggering gait, are extremely nervous, tremble, and may even fall. Ergot poisoning can also result in abortion and in loss of hooves and hair.

Molybdenum Poisoning

Some soils in the West have an excess of molybdenum. Legumes growing on such soils almost always contain enough molybdenum to be toxic to cattle and sheep. Grasses, however, pick up little molybdenum. If soils contain a high amount of molybdenum consult your county agricultural agent for further information.

Temporary Pastures

Sometimes temporary pastures are needed to supplement pastures with perennial plants. Sudangrass, millet, certain legumes, and small grains make good temporary pasture. Winter wheat and winter rye make excellent early spring pasture. But be careful in seeding cereal rye in commercial wheat-growing areas. Winter oats or winter barley are used only where winterkilling is not a problem. Where winterkilling is a problem, use spring grains for early summer grazing. Sudangrass, where adapted, is an excellent warm-season grass for forage during the heat of summer. Common ryegrass seeded in early fall can supplement a warm-season grass such as dallisgrass or bermudagrass.

In planning temporary pastures, it is best to consult the local county agent or SCS conservationist for specific information about the area.

For sale by the Superintendent of Documents, U.S. Government Printing Office
Washington, D.C. 20402 - Price 15 cents

U.S. GOVERNMENT PRINTING OFFICE: 1967 O—268-794